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TESTING OF HARDENED GLASS FOR THE TYPE OF FRACTURE

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By means of experiment, the number and the shape of fragments of a fractured sample of hardened sheet glass were determined.

All calculation and experimental methods for predicting the type of fracture of hardened sheet glass make it possible to determine the total number of fragments per prescribed surface area of 5×5 cm^2, assuming a uniform distribution of fragments over this area. For simplification, it is assumed that the fragments have an identical shape (parallelepiped) and an equal surface area. However, reality demonstrates this not to be so. Fragments resulting from hardened glass fractures have different shapes.

Therefore, the purpose of this study was to determine the number and the shape of fragments in a fractured sample.

The testing was performed on 4-mm sheet glass hardened in laboratory conditions. This was dethermal greenish glass produced at the Saratov Institute of Glass.

The sample was fractured by inflicting a blow to the center of the sample with a special hammer (GOST 5727–88), after which the shape and the number of the fragments within the limits of the sample surface area were visually estimated.

The results obtained for the total surface area of the sample (89.25 cm^2) are shown in Table 1.

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TABLE 1

Fragment shape in plane	Symbol	Number of fragments	Percent of total number of fragments
Triangular	△	55	~ 8
Tetragonal:			
square	□	328	~ 48
rectangular	▭	75	~ 11
Pentagonal	⬠	146	~ 21.2
Hexagonal	⬡	84	~ 11.8

It can be seen that the shape of the fragments varies, and any geometrical configurations are possible: from triangular shape to a nearly circular (hexagonal) shape. The spread in the number of fragments of various shapes is obvious: the predominant number (almost half of the total quantity) is taken by square-shaped fragments, and triangular fragments have the smallest share (8%).

The number of fragments converted to the prescribed surface area 5×5 cm^2 for the considered hardening conditions was equal to:

$$N = \frac{688 \times 25}{89.25} = 193.$$

The earlier proposed method for calculation of the number of fragments [1] yields the following results. The average length of the fragment base side

$$Z_{\mathrm{av}} = \frac{4}{\pi}\left(\frac{6E\gamma}{\sigma_{\mathrm{av}}^2(1-2\nu)} + \frac{\delta}{\sqrt{3}}\right),$$

where E is the Young modulus (0.68×10^{11} Pa); γ is the specific surface energy (2.1 J/m^2); σ_{av} is the central tensile stress (0.55×10^8 Pa); ν is the Poisson coefficient (0.22); δ is

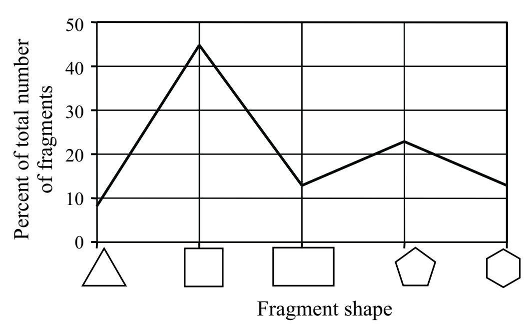

Fig. 1

the glass thickness (0.004 m), and with the preset numeric expression $Z_{av} = 0.00357$ m, the number of rows of fragments should be:

$$n = \frac{0.05}{Z} = \frac{0.05}{0.00357} = 14.$$

In this case $N = n^2 = 196$, which well agrees quantitatively with the specified experimental value.

The shape distribution of the fragments is shown in Fig. 1, which corroborates the results given in Table 1.

Thus, the earlier accepted [1] calculation assumptions of a unique shape of the fragment are admissible. However, fragments of different shapes (especially triangular ones) can present a danger in emergency situations in the course of transportation.

REFERENCES

1. A. I. Shutov, P. V. Popov, and A. B. Bubeev, "Prediction of the type of fracture of hardened glass," *Steklo Keram.*, No. 1, 8 – 10 (1998).